

General

Title

Pediatric readmissions: percentage of admissions followed by one or more readmissions within 30 days, following hospitalization for lower respiratory infection (LRI) in patients less than 18 years old.

Source(s)

Center of Excellence for Pediatric Quality Measurement (CEPQM). Basic measure information: pediatric lower respiratory infection readmission. Boston (MA): Center of Excellence for Pediatric Quality Measurement (CEPQM), Boston Children's Hospital; 13 p.

Center of Excellence for Pediatric Quality Measurement (CEPQM). Pediatric lower respiratory infection readmission measure: detailed specifications. Boston (MA): Center of Excellence for Pediatric Quality Measurement (CEPQM), Boston Children's Hospital; 2014 Feb. 33 p. [2 references]

Measure Domain

Primary Measure Domain

Related Health Care Delivery Measures: Use of Services

Secondary Measure Domain

Does not apply to this measure

Brief Abstract

Description

This measure calculates case-mix-adjusted readmission rates, defined as the percentage of admissions followed by one or more readmissions within 30 days, following hospitalization for lower respiratory infection (LRI) in patients less than 18 years old.

This measure focuses on patients discharged from general acute care hospitals, including children's hospitals.

Rationale

Lower respiratory infection (LRIs), consisting of bronchiolitis, influenza, and community-acquired pneumonia (CAP), are among the most common reasons for pediatric hospitalization. Bronchiolitis and CAP are also 2 of the 10 admission diagnoses with the highest readmission prevalence in children (Berry et al., 2013). Hospitalizations for LRI-related care impose significant clinical, social, and financial burdens upon patients and families. Reducing LRI readmissions could alleviate these burdens and reduce health care costs.

Readmissions disrupt the lives of patients and families, expose patients to risks of harm during hospitalization, and are costly. The number of children who experience readmissions is substantial. Overall, readmissions within 30 days occur for 2% to 6% of pediatric hospitalizations (Berry et al., 2013; Jencks, Williams, & Coleman, 2009; Wick et al., 2011; Jiang & Wier, 2010). Thirty-day readmissions occur for 3.7% to 4.5% of pediatric bronchiolitis hospitalizations and 4.5% of pediatric pneumonia hospitalizations (Berry et al., 2013; Kemper et al., 2005). Because LRIs are such a common reason for hospitalization, the absolute number of readmissions following LRI hospitalizations is high. Readmissions signal the quality of disease management, indicating a worsening of health status that in some cases may have been prevented. They also reflect the quality of key processes, including discharge planning and education, care transitions, and follow-up care. Disparities in pediatric readmission rates exist based on race/ethnicity, socioeconomic status, and special health care needs. For example, children with pre-existing neurologic conditions are more likely to develop influenza complications and are at a higher risk for readmission following hospitalization for influenza (Bhat et al., 2005).

Evidence for Rationale

Berry JG, Toomey SL, Zaslavsky AM, Jha AK, Nakamura MM, Klein DJ, Feng JY, Shulman S, Chiang VW, Chiang VK, Kaplan W, Hall M, Schuster MA. Pediatric readmission prevalence and variability across hospitals. *JAMA*. 2013 Jan 23;309(4):372-80. [PubMed](#)

Bhat N, Wright JG, Broder KR, Murray EL, Greenberg ME, Glover MJ, Likos AM, Posey DL, Klimov A, Lindstrom SE, Balish A, Medina MJ, Wallis TR, Guarner J, Paddock CD, Shieh WJ, Zaki SR, Sejvar JJ, Shay DK, Harper SA, Cox NJ, Fukuda K, Uyeki TM, Influenza Special Investigations Team. Influenza-associated deaths among children in the United States, 2003-2004. *N Engl J Med*. 2005 Dec 15;353(24):2559-67. [PubMed](#)

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Primary Health Components

Lower respiratory infection (LRI); pediatric readmissions

Denominator Description

Hospitalizations at general acute care hospitals for lower respiratory infection (LRI) in patients less than 18 years old (see the related "Denominator Inclusions/Exclusions" field)

Numerator Description

Hospitalizations at general acute care hospitals for lower respiratory infection (LRI) in patients less than 18 years old that are followed by one or more readmissions to general acute care hospitals within 30 days (see the related "Numerator Inclusions/Exclusions" field)

Evidence Supporting the Measure

Type of Evidence Supporting the Criterion of Quality for the Measure

A formal consensus procedure, involving experts in relevant clinical, methodological, public health and organizational sciences

A systematic review of the clinical research literature (e.g., Cochrane Review)

One or more research studies published in a National Library of Medicine (NLM) indexed, peer-reviewed journal

Additional Information Supporting Need for the Measure

Prevalence of Lower Respiratory Infection (LRI)

Bronchiolitis, influenza, and community-acquired pneumonia (CAP) are highly prevalent in the pediatric population. Annually, bronchiolitis affects 26 in 1,000 children 0 to 2 years old (Pelletier, Mansbach, & Camargo, 2006; Mansbach, Emond, & Camargo, 2005). Respiratory syncytial virus (RSV), the leading cause of bronchiolitis, infects nearly 90% of children during the first 2 years of life, 40% of whom develop bronchiolitis (American Academy of Pediatrics Subcommittee on Diagnosis and Management of Bronchiolitis, 2006). Influenza attack rates are highest in children and range from 15% to 70% annually (Carr, 2012). Influenza most commonly affects children 5 to 18 years old (Carr, 2012). During the 2009 A(H1N1) pandemic alone, 20 million children acquired the infection (Chang et al., 2012). The prevalence of pediatric CAP decreases with age. A study using 2006 data from children's and nonchildren's hospitals estimated that 912 in 100,000 children less than 1 year old acquired CAP. The corresponding rates for children 1 to 5, 6 to 12, and 13 to 18 years old were 390/100,000, 84/100,000, and 62/100,000, respectively (Lee et al., 2010).

LRI Hospitalization and Readmission Rates Vary by Age

The prevalence of LRI-related hospitalizations and readmissions varies significantly by age. Bronchiolitis is the leading cause of hospitalization in infants (Pelletier, Mansbach, & Camargo, 2006). Influenza hospitalization rates are highest for children less than 6 months old (Carr, 2012). The rate of pneumonia hospitalization is highest in children less than 2 years old, at 1,000 hospitalizations per 100,000 children, and decreases with age (Griffin et al., 2013). The relationship of age to bronchiolitis or influenza readmission risk has not yet been reported. Readmissions for pneumonia are most prevalent in older children. One study found that readmission rates following pneumonia hospitalizations were 1.9% for children 12 to 18 years old, 1.2% in children 1 to 5 years old, and 0.9% in children 6 to 11 years old ($p < 0.001$) (Weiss et al., 2011). Another study found a similar age-associated trend in pediatric pneumonia readmission rates (Brogan et al., 2012).

Social and Clinical Burdens of LRI and LRI Readmission

Hospitalization of a child is disruptive to families. It can affect parent/caregiver work and sibling school or daycare arrangements and expose families to various psychosocial stressors (Shudy et al., 2006; Rennick et al., 2002). Infants hospitalized for bronchiolitis, for example, are commonly discharged prior to full recovery. As a result, parents must take time off from work, keep their child out of day care, and schedule additional medical visits (Robbins et al., 2006). Readmission also exposes patients to additional hospital days and thus increased potential for further infections and medical errors, which are common during hospitalization (Aspden et al., 2007; Kohn, Corrigan & Donaldson, 2000).

Fiscal Burden of LRI and LRI Readmission

LRIs and LRI readmissions among pediatric patients are costly. The average cost of bronchiolitis-associated hospitalizations is \$9,063 per child (Willson et al., 2003). Furthermore, the development of chronic complications from bronchiolitis, such as asthma, poses a significant long-term financial burden (American Academy of Pediatrics Subcommittee on Diagnosis and Management of Bronchiolitis, 2006). The total estimated annual cost of pediatric influenza is \$1.67 billion, with costs of approximately \$55 million per hospital annually (Molinari et al., 2007; Ampofo et al., 2006). Costs of influenza hospitalization to patients and families are also substantial and include direct costs of medical care as well as indirect costs such as school absenteeism and parental work loss (Weycker et al., 2005). The average cost of hospitalization for CAP (for children and adults) is \$12,000 per patient (Paladino et al., 2007).

Association of Readmission with Children's Future Health

Frequent hospitalization may have negative developmental effects, including anxiety and feelings of isolation, particularly for children who are chronically ill and return to school after prolonged hospitalizations (Worchel-Prevatt et al., 1998). Frequently-hospitalized adolescents are more likely to drop out of school than their healthy peers (Weitzman et al., 1982; Kearney, 2008). School reintegration can be complicated by side effects caused by treatment or the illness itself or by increased social, emotional, and behavioral problems (Shaw & McCabe, 2008).

Potential for LRI Quality Improvement

Studies have shown hospital-level variation in pediatric readmission rates for LRI, suggesting there is potential for improvement in the quality of LRI care. One study found significant variation among children's hospitals in 3-day pediatric bronchiolitis readmission rates, which ranged from 0% to 2.7% ($p < 0.001$) (Christakis et al., 2005). Another study of children's hospitals found significant variation in risk-adjusted 30-day readmission rates for admission diagnoses of bronchiolitis and pneumonia (Berry et al., 2013). Effective interventions to reduce LRI readmissions have been demonstrated (Cheney et al., 2005; Pillai et al., 2011; Dean et al., 2006). For bronchiolitis, for example, implementation of a clinical pathway with management and discharge criteria significantly reduced 14-day readmission rates (Cheney et al., 2005). For pneumonia, improvements during hospitalization in use of recommended antibiotics, communication of discharge information to patients, and use of electronic medical records have reduced readmission rates (Schmeida & Savrin, 2012; Jones, Friedberg, & Schneider, 2011). Unplanned readmissions following hospitalization for LRI care are commonly for complications of the original disease. Interventions aimed at preventing these complications when possible, or better managing them when they occur, could potentially reduce readmissions. The most common complications for bronchiolitis are asthma and other chronic respiratory problems (Willson et al., 2003; Bacharier et al., 2012). Neurologic conditions are increasingly frequent complications of influenza (Bhat et al., 2005; Effler, 2012; Keren et al., 2005). Local complications of pneumonia, such as empyema, lung abscess, and necrotizing pneumonia, are becoming more prevalent, particularly in younger children (Keren et al., 2005; Grijalva et al., 2010).

Evidence for Additional Information Supporting Need for the Measure

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Extent of Measure Testing

Reliability

The measure was developed and tested using multiple claims datasets. These included 2008 Medicaid Analytic eXtract (MAX) data for 26 states, which include Medicaid claims from children's and non-children's hospitals; 2005 to 2009 Agency for Healthcare Research and Quality (AHRQ) revisit data for New York and Nebraska, which include claims for all payers from children's and non-children's hospitals; July 2009 to June 2010 National Association of Children's Hospitals and Related Institutions (NACHRI) case-mix data, which include claims for all payers from 72 acute care children's hospitals in 34 states; and the 2009 Kids' Inpatient Database (KID), which includes claims for all payers from children's and non-children's hospitals in 44 states. For the MAX and AHRQ revisit datasets, the developer chose which states' data to use based on assessment of data quality and completeness. All of the datasets except the KID can be used to evaluate readmissions (although the NACHRI Case-mix data only allow identification of readmissions back to the same hospital); the KID provides other useful information about pediatric hospitalizations, such as frequencies of specific conditions and procedures, and can be weighted to produce national estimates.

The reliability of hospital-level readmission rates was evaluated using the formula shown in the supplemental materials (refer to the original measure documentation for additional information). Reliability values range from 0 to 1. If perfect information from a very large sample were available for a hospital, so the hospital's random effect could be determined with perfect precision, then the reliability of that hospital's readmission rate would approach 1. If no information were available for a hospital, then the reliability of that hospital's readmission rate would be 0.

Using the 26-state MAX dataset, it was determined that for hospitals with at least 25 pediatric lower respiratory infection (LRI) admissions annually, the median reliability for hospital-level LRI readmission rates was 0.46 (interquartile range 0.35 to 0.61). Reliability was greater than 0.5 for hospitals with at least 76 index admissions annually. Seventy-three percent (73%) of index hospitalizations occurred at hospitals whose readmission rate reliability was at least 0.5, while 41% of index hospitalizations occurred at hospitals whose readmission rate reliability was at least 0.7.

Use of hospital random effects in the case-mix adjustment model adjusts the readmission rate estimate toward the mean rate for the entire cohort of hospitals, more so for hospitals with low volume and correspondingly low readmission rate reliability (because for a hospital with little available data,

estimation of the hospital's rate relies more on assumptions about the distribution of hospital rates than for a hospital with a large amount of data). As a result, a hospital that has a high or low unadjusted readmission rate but insufficient volume to estimate its readmission rate precisely is prevented from appearing to be an outlier when it might not be.

Validity

The validity of the measure's case-mix adjustment model was evaluated by assessing the discriminative ability of the model using the concordance (c-) statistic (Austin & Steyerberg, 2012; Steyerberg et al., 2010). Discrimination refers to how well the model distinguishes between subjects with and without the outcome (in this case, readmission) (Austin & Steyerberg, 2012). The c-statistic is a unitless measure of the probability that a randomly selected subject who experienced readmission will have a higher predicted probability of having been readmitted than a randomly selected subject who did not experience readmission (Austin & Steyerberg, 2012). The c-statistic for the case-mix adjustment model, when applied to the 26-state MAX dataset, was 0.71, which is very much in range with results for other 30-day readmission models (Yale New Haven Hospital Services Corporation [YNHHSC] Center for Outcomes Research and Evaluation [CORE], "Hospital-wide," 2012; YNHHSC CORE, "Hospital-level," 2012; YNHHSC CORE, 2013; Rice-Townsend et al., 2013).

Evidence for Extent of Measure Testing

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State of Use of the Measure

State of Use

Current routine use

Current Use

not defined yet

Application of the Measure in its Current Use

Measurement Setting

Hospital Inpatient

Professionals Involved in Delivery of Health Services

not defined yet

Least Aggregated Level of Services Delivery Addressed

Single Health Care Delivery or Public Health Organizations

Statement of Acceptable Minimum Sample Size

Specified

Target Population Age

Age less than 18 years

Target Population Gender

Either male or female

National Strategy for Quality Improvement in Health Care

National Quality Strategy Priority

Institute of Medicine (IOM) National Health Care Quality Report Categories

IOM Care Need

Not within an IOM Care Need

IOM Domain

Not within an IOM Domain

Data Collection for the Measure

Case Finding Period

Unspecified

Denominator Sampling Frame

Patients associated with provider

Denominator (Index) Event or Characteristic

Clinical Condition

Institutionalization

Patient/Individual (Consumer) Characteristic

Denominator Time Window

not defined yet

Denominator Inclusions/Exclusions

Inclusions

Hospitalizations at general acute care hospitals for lower respiratory infection (LRI) in patients less than 18 years old

Note: These hospitalizations are identified using a case definition that requires either a primary International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) diagnosis code or a principal International Classification of Diseases, Tenth Revision, Clinical Modification (ICD-10-CM) diagnosis code for bronchiolitis, influenza, or community-acquired pneumonia (CAP) or a secondary ICD-9-CM or additional ICD-10-CM diagnosis code for one of these LRIs plus a primary ICD-9-CM or a principal ICD-10-CM diagnosis code for asthma, respiratory failure, or sepsis/bacteremia.

Refer to the original measure documentation for ICD-9-CM and ICD-10-CM codes for case ascertainment and clinical exclusions.

Exclusions

The patient was 18 years old or greater at the time of discharge.

The hospitalization was for birth of a healthy newborn.

The hospitalization was for obstetric care, including labor and delivery.

The primary diagnosis code was for a mental health condition.

The hospitalization was at a specialty or non-acute care hospital.

The discharge disposition was death.

The discharge disposition was leaving the hospital against medical advice.

Records for the hospitalization contain incomplete data for variables needed to assess eligibility for the measure or calculate readmission rates, including hospital type, patient identifier, admission date, discharge date, disposition status, date of birth, primary diagnosis code, or gender.

The hospital is in a state not being analyzed. (Records for these hospitalizations are still assessed as possible readmissions, but readmission rates are not calculated for the out-of-state hospitals due to their lack of complete data.)

Thirty days of follow-up data are not available for assessing readmissions.

The hospital has less than 80% of records with complete patient identifier, admission date, and discharge date or less than 80% of records with complete primary diagnosis codes. (Records for these hospitals are still assessed as possible readmissions, but readmission rates are not calculated for these hospitals due to their lack of complete data.)

Records for the hospitalization contain data of questionable quality for calculating readmission rates, including

- Inconsistent date of birth across records for a patient

- Discharge date prior to admission date

- Admission or discharge date prior to date of birth

- Admission date after a discharge status of death during a prior hospitalization

Codes other than ICD-9-CM procedure codes or International Classification of Diseases, Tenth Revision, Procedure Coding Systems (ICD-10-PCS) procedure codes are used for the primary procedure.

Exclusions/Exceptions

not defined yet

Numerator Inclusions/Exclusions

Inclusions

Hospitalizations at general acute care hospitals for lower respiratory infection (LRI) in patients less than 18 years old that are followed by one or more readmissions to general acute care hospitals within 30 days

Exclusions

Readmissions are excluded from the numerator if the readmission was for a planned procedure or for chemotherapy.

Note:

Readmissions for planned procedures and for chemotherapy are part of a patient's intended course of care and thus unlikely to be related to health system quality. This measure therefore focuses on unplanned readmissions because they are more likely to be related to a defect in quality of care during the index admission or during the interval between the index admission and readmission. In adult and pediatric medicine, most planned readmissions are for planned procedures or chemotherapy; therefore, these exclusions are intended to capture the majority of planned admissions.

Planned Procedure: A procedure that was judged by expert reviewers to generally be scheduled at least 24 hours in advance for an expected medical need in more than 80% of cases and to be a potential reason for hospitalization (see Data Dictionary for International Classification of Diseases, Ninth Revision, Clinical Modification [ICD-9-CM] or International Classification of Diseases, Tenth Revision, Clinical Modification [ICD-10-CM] procedure codes).

Planned Readmission: An admission to an acute care hospital with a primary ICD-9 or principal ICD-10 procedure code for a planned procedure, occurring within 30 days of discharge from a prior acute care hospitalization.

Index Admission: An eligible admission to an acute care hospital. The index admission serves as the starting point for enumerating readmissions.

Numerator Search Strategy

Institutionalization

Data Source

Administrative clinical data

Type of Health State

Proxy for Health State

Instruments Used and/or Associated with the Measure

Unspecified

Computation of the Measure

Measure Specifies Disaggregation

Does not apply to this measure

Scoring

Rate/Proportion

Interpretation of Score

Does not apply to this measure (i.e., there is no pre-defined preference for the measure score)

Allowance for Patient or Population Factors

not defined yet

Description of Allowance for Patient or Population Factors

The model for this measure consists of a 2-level hierarchical logistic regression with fixed effects for patient-level characteristics and a random intercept for hospital. The first level of the model includes adjusters for hospital case-mix based on the patient-level characteristics of age, gender, and chronic disease comorbidity (identified using the Agency for Healthcare Research and Quality [AHRQ] chronic condition indicator tool). The second level of the model consists of a random effect for hospital. The hierarchical modeling adjusts for differences in case-mix and sample size across hospitals.

Refer to the original measure documentation for additional information.

Standard of Comparison

not defined yet

Identifying Information

Original Title

Pediatric lower respiratory infection readmission measure.

Measure Collection Name

Readmission Measures

Submitter

Center of Excellence for Pediatric Quality Measurement, Boston Children's Hospital - Hospital/Medical Center

Developer

Center of Excellence for Pediatric Quality Measurement, Boston Children's Hospital - Hospital/Medical Center

Funding Source(s)

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Composition of the Group that Developed the Measure

Pediatric Readmissions Working Group

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Financial Disclosures/Other Potential Conflicts of Interest

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Adaptation

This measure was not adapted from another source.

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Measure Status

This is the current release of the measure.

Measure Availability

Source not available electronically.

For more information, contact the Boston Children's Hospital at 300 Longwood Avenue, Boston, MA 02115; Phone: 617-355-6000, or 800-355-7944; Web site: www.childrenshospital.org

NQMC Status

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Production

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Center of Excellence for Pediatric Quality Measurement (CEPQM). Pediatric lower respiratory infection readmission measure: detailed specifications. Boston (MA): Center of Excellence for Pediatric Quality Measurement (CEPQM), Boston Children's Hospital; 2014 Feb. 33 p. [2 references]

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